AMBIENT AIR QUALITY IN WINDSOR

Annual Report 1979

Ministry of the Environment
Ontario

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IN
WINDSOR

Annual Report 1979

Technical Support Section
Southwestern Region

ONTARIO MINISTRY OF THE ENVIRONMENT
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SUMMARY

A trend of improvement in ambient air quality in Windsor continued through 1979. Average levels of dustfall, oxides of nitrogen, total hydrocarbons and fluoridation rates were lower in 1979 than in 1978. Criteria for desirable ambient air quality established for sulphur dioxide, carbon monoxide and nitrogen dioxide continued to be met during 1979. The Air Pollution Index indicated a satisfactory level during 1979 throughout the entire year.

The trend of decreasing levels of total suspended particulates, which was very strong from 1972 through 1975, did not exist in 1979, with annual levels from 1976 to 1979 being very similar. Much of the impact on levels of total suspended particulates stems from emissions in Wayne County, Michigan. However, despite improvements in emission controls, two sources of particulates in Windsor, the scrap metal operations of Zalev Bros. and the casting plant of Ford Motor Company of Canada, Limited, continued to adversely affect localized areas of Windsor. In general, the areas around these two sources, downtown Windsor and west Windsor, had unsatisfactory levels of total suspended particulates during 1979. Levels of heavy metals in total suspended particulates remained well within the criteria for desirable ambient air quality.

INTRODUCTION

The Ontario Ministry of the Environment operates a network of ambient air monitors to measure the levels of a number of pollutants that may directly or indirectly adversely affect health, vegetation or the enjoyment of property. Data on the levels of pollutants are compared with criteria for desirable ambient air quality, listed in The Environmental Protection Act, 1971. Data are also used to determine trends in air quality and therefore the effectiveness of pollution abatement, as well as to provide information on the effect of specific sources of pollutants and to formulate strategies to control pollution.

In addition to the monitoring of ambient air quality described in this report, the Ministry conducts phytotoxicology surveys to determine the effects of air pollutants on vegetation. Also, levels of pollutants in the atmosphere are predicted using mathematical models and emissions from specific sources.

DESCRIPTION OF MONITORING NETWORK

At fixed sites throughout the Windsor area, the Ministry operates continuous and intermittent ambient air monitors. Monitoring is more intensive in the downtown area, where emissions from motor vehicles and commercial establishments are most notable, and in west Windsor, which is the location of the J. C. Keith Generating Station of Ontario Hydro and is close to a heavily industrialized portion of Wayne County, Michigan.

During 1979 a new site, station No. 12039, was operated in south Windsor to determine levels of total suspended particulates. Also, 3 new fluorescent-type monitors for sulphur dioxide replaced 3 coulometric-type monitors at stations 12008, 12016 and 12032.

The locations of the Ministry's monitoring stations in the Windsor area are illustrated in Appendix 1, Figure 1 and are described in Table 1 of the same Appendix. Also shown in Figure 1 are the locations of 5 monitoring sites at which Ontario Hydro operates sulphur dioxide monitors. The sites of Ontario Hydro are located in different directions from the J. C. Keith Generating Station at distances ranging from 5 to 7 kilometres. The pollutants monitored at the various Ministry stations are shown in Table 2.

Ontario's criteria for desirable ambient air quality with respect to the pollutants monitored on a routine basis in Windsor, and the prime factors supporting these criteria are contained in Appendix 1, Table 3.

METEOROLOGICAL DATA

Meteorological data are obtained from the Ministry's stations 12032 and 12034. At station 12032, located in the Morton Dock area of west Windsor, wind speed and direction are measured at levels 7 metres and 30 metres above ground.

At station 12034, located close to downtown Windsor and the Detroit River, data are collected for wind speed and direction at 10-metre and 46-metre levels, as well as ambient temperature at the 10-metre level and the difference in ambient temperatures between the two levels. Close to station 12034 a tall building has recently been erected which distorts the wind speed and direction measurements. Consequently, data from station 12032 are considered more reliable and are therefore principally utilized.

The data collected at these stations are used to forecast meteorological conditions in association with the Air Pollution Index. Also, data are correlated with other pollutants such as suspended particulates, sulphur dioxide and ozone to determine sources of pollutants.

A summary of meteorological data collected from 1972 through 1979 appears in Appendix 2, Table 4. The data for all years except 1978 come from station 12032. The 1978 data are from station 12034 since much of the 1978 data for station 12032 was lost because of equipment problems.

PARTICULATES

The iron and steel industry, foundries, power generating plants utilizing fossil fuels and road traffic are primary sources of particulates that adversely affect

air quality in Windsor. Wind-blown particles from open fields, sand and coal piles, roadways and roofs are also significant sources.

Measurements for particulates are reported as suspended particulates, dustfall and soiling index. Levels of suspended particulates are determined by drawing measured volumes of air through a filter for 24 hours and subsequently weighing the quantity of particulates collected on the filter. Dustfall is measured by exposing open cylinders (jars) of known diameter for 30 days and subsequently weighing the amount of particulates collected in the jar.

Soiling index is determined by measuring the difference in the amount of light transmitted through a filter before and after ambient air is drawn through the filter for periods of 1 or 2 hours. The amount of light transmitted through the filter is affected by the quantity, size, shape and opaqueness of particulates retained on the filter. Light transmitted through the filter is measured by a photoelectric cell and the soiling index may be calculated immediately. This immediate availability of the soiling index in contrast to the time-consuming laboratory analysis required for total suspended particulates has resulted in the soiling index being used in the Air Pollution Index as an indicator of levels of suspended particulates.

SUSPENDED PARTICULATES

Two criteria for desirable ambient air quality exist for suspended particulates. One is 120 micrograms of suspended particulates per cubic metre of air (ug/m^3) averaged over a 24-hour period. The other is an annual geometric mean of 60 ug/m^3. The criterion for 24 hours is based on impairment of visibility and adverse health

effects associated with combined concentrations of sulphur dioxide and suspended particulates. The annual criterion is based on public awareness of suspended particulates and property damage.

During 1979 filters were exposed to collect suspended particulates at 13 sites in the Windsor area on a sampling frequency of every sixth day. The 24-hour criterion was exceeded at all sites except station 12010, the most easterly station in Windsor. This is the first time that the level of total suspended particulates at a Windsor station has not exceeded the 24-hour criterion during the period of one calendar year. The annual criterion was exceeded at 11 of the 13 sites. The 2 sites where this criterion was met were situated in the Riverside area of east Windsor. A summary of data for 1972 to 1979 is presented in Appendix 3, Table 5.

Figure 2 of Appendix 3 illustrates the annual geometric mean concentrations and the percent frequency of excursions above the 24-hour criterion at the approximate locations of the monitoring stations. It is apparent from this figure that the Riverside area of east Windsor has on the average appreciably lower levels of total suspended particulates than west Windsor, downtown Windsor or the area in the immediate vicinity of the casting plant of Ford Motor Company of Canada, Limited.

A sufficient quantity of data for total suspended particulates for 1979 was available at 13 monitoring sites to permit correlation with data for wind direction from station 12032, located at Morton Dock. The correlations are presented in Figure 3 of Appendix 3 with the longer lines indicating higher correlations. The correlations indicate that at all stations higher levels of suspended particulates were associated with winds from the south-west quadrant.

This is to be expected since a large quantity of emissions originate in Wayne County upwind of Windsor in a southwesterly direction and since poorer dispersion conditions are frequently associated with the backs of high pressure systems moving in northerly and northeasterly directions. However, for stations 12015 and 12032 the influence of emissions from the Zug Island area is indicated by correlation lines in the northwest quadrant. Similarly the influence of emissions from Zalev Bros., a scrap metal operation, is suggested by correlation lines in the northeast quadrant for station 12039, as well as by elevated iron levels in particulates as discussed in the next subsection of this report.

Both the annual geometric mean and the frequency of values greater than the 24-hour criterion increased appreciably at station 12014, located in west Windsor near the University of Windsor. The elevated levels of suspended particulates persisted at this station throughout much of 1979 and the increase could not be connected to a specific reason such as local construction activity. Dustfall measurements at this station were on the average lower in 1979 than in 1978.

Total suspended particulate levels at station 12013, located near the casting plant of Ford Motor Company of Canada, Limited, remained high in 1979 despite implementation of major control equipment on emission sources at the casting plant during 1978 and 1979. However, appreciable emissions from local construction activity would have contributed more to the levels of particulates measured during 1979 than in previous years.

Figure 4, Appendix 3 contains a bar graph of the average of the annual geometric means for eight stations monitored during the years 1972 through 1979. Also, included in Figure 4 is a bar graph of the average frequencies of excursions above the 24-hour criterion for the

same 8 stations from 1972 through 1979. These bar graphs illustrate the improvement in levels of particulates from 1972 to 1975 and the absence of appreciable change from 1975 through 1979.

Chemical Analysis of Suspended Particulates

As part of a Province-wide study, samples of suspended particulates collected at various stations in Windsor were analyzed quantitatively for cadmium, chromium, copper, iron, lead, manganese, nickel, nitrates, sulphates and vanadium. A summary of these data collected from 1976 through 1979 is contained in Appendix 3, Table 6.

Criteria for desirable ambient air quality exist for cadmium, lead, nickel and vanadium. Concentrations of the various metals have been low with no values above the criteria. There is no apparent trend of increasing levels of metals, nitrates or sulphates in suspended particulates.

At station 12013 iron levels in total suspended particulates are occasionally more elevated (greater than 10 ug/m^3) when prevailing winds are from the general direction of the casting plant of Ford Motor Company of Canada, Limited. Similarly 3 of the 56 samples of total suspended particulates collected at station 12039 had iron values greater than 10 ug/m^3 and these elevated iron values were associated with prevailing winds from the direction of Zalev Bros., a scrap metal operation with iron emissions.

DUSTFALL

The criteria for desirable ambient air quality established for dustfall are a 30-day loading of 7.0 grams of dustfall per square metre ($g/m^2/30$ days) and an annual average of 4.6 $g/m^2/30$ days. These criteria were established on the basis of historical data and standards developed by other enforcement agencies.

During 1979 the annual criterion was exceeded at 15 of the 21 sites monitoring dustfall. The 30-day criterion was met each month at 3 of the 21 sites while the frequency of exceeding the 30-day criterion ranged as high as 80 percent at the other 17 sites. The 1979 dustfall data are listed in Table 7, Appendix 3. Figure 5 depicts the annual averages for dustfall and the frequencies of excursions above the 30-day criterion as determined for different monitoring stations during 1979.

The loadings for dustfall and the percentage of values greater than the 30-day criterion were generally lower during 1979 than in previous years. A trend of gradually decreasing loadings and excursions is depicted in Figure 6 which was constructed from data averaged from 14 monitoring sites that operated from 1972 to 1979.

Dustfall measurements are comprised of a larger proportion of heavy particulates than are total suspended particulate measurements. Consequently, the steady trend of decreasing levels of dustfall compared to the absence of a decreasing trend in levels of total suspended particulates in recent years indicates that the overall control of emissions of heavy particulates has continued to improve.

SULPHUR OXIDES

Combustion of sulphur-containing fuels comprises the predominant source of man-made emissions of sulphur oxides. Therefore, primary emitters of sulphur oxides are power plants and industries utilizing fossil fuels to meet requirements for large amounts of energy.

During 1979 sulphur oxides were measured in Windsor as gaseous sulphur dioxide and sulphate in suspended particulate matter. Continuous measurements of gaseous sulphur dioxide were made primarily by analyzers utilizing coulmetric technology. Late in 1979 three new gaseous sulphur dioxide monitors which utilize fluorescence technology were brought on-line. Data for sulphate in suspended particulates are presented in the summary table (Table 6, Appendix 3) supporting the section on the Chemical Analysis of Suspended Particulates.

SULPHUR DIOXIDE

The criteria for desirable ambient air quality with respect to sulphur dioxide are 0.25 parts of sulphur dioxide per million parts of air (ppm) averaged for 1 hour, 0.10 ppm averaged for 24 hours and 0.02 ppm as an annual average. The 1-hour and annual criteria were established for the protection of vegetation while the 24-hour criterion serves to protect human health.

During 1979 gaseous sulphur dioxide was measured continuously by the Ministry of the Environment at five fixed locations in west, east and downtown Windsor. For the second consecutive year the data from all monitoring sites met the criteria for desirable ambient air quality. Also, although the data are not reported in this report, the criteria were met during 1979 at the 5 monitoring sites maintained by Ontario Hydro in the Windsor area.

A summary of 1979 Ministry data for sulphur dioxide is presented in Table 8, Appendix 4. Figure 7 graphically displays the trend of decreasing levels of sulphur dioxide reported for stations 12008 and 12032 since 1972. The improvements in levels of sulphur dioxide are attributable to better control and dispersion of emissions of sulphur dioxide in Wayne County, Michigan and Windsor.

Pollution roses for sulphur dioxide at each station during 1979 are presented in Figure 8, Appendix 4. The roses were developed by determining the average concentrations of sulphur dioxide that corresponded to 16 wind directions. Data for wind direction were measured at the 30-metre level of station 12032, located at the Morton Dock in west Windsor. The pollution roses indicate an influence of sources of sulphur dioxide located in Wayne County, Michigan, but these were not sufficient to deteriorate air quality above the desirable criteria.

AIR POLLUTION INDEX

The Air Pollution Index (API) is a system designed to control or prevent an air pollution episode. Meteorological forecasting and readings of sulphur dioxide and suspended particulates are utilized to predict the potential for the persistence of deteriorating air quality conditions that are numerically reported as the API.

Data for suspended particulates are provided by the measurement of soiling index and a correlation between concentrations of suspended particulates and soiling index. Hourly values of soiling index and gaseous sulphur dioxide are used to compute 24-hour running averages which are inserted into the following equation.

$$API = 7.89\ (18.26\ COH + 156.7\ SO_2)^{1.06}$$

where: COH is the 24-hour average for soiling index expressed in co-efficient of haze units.

SO_2 is the 24-hour average concentration of sulphur dioxide expressed in parts per million.

API values up to 32 are considered acceptable. Values from 32 to 49 are at the Advisory Level and if adverse weather conditions are likely to persist, contributors of major emissions are advised to prepare to curtail operations. At an API of 50 major emitters may be ordered to curtail operations. At 75, further cutbacks can be required. When the API reaches 100 all industries and other contributors of pollution not essential to public health and safety can be ordered to cease operations.

Although the API is based on the control of combined levels of sulphur dioxide and suspended particulates, emissions of other pollutants are controlled simultaneously. However, situations may occur where levels of certain pollutants such as ozone are high and the API may be in the acceptable range. These conditions would be normally detected by other instruments utilized in the Ministry's monitoring program.

Levels of soiling index and sulphur dioxide utilized for the computation of two separate API's are obtained at station 12008, in downtown Windsor, and at station 12016 in west Windsor. During 1979 the API did not exceed the acceptable range at either station 12008 or station 12016, the respective maximum values reported for each station being 31 and 27.

CARBON MONOXIDE

Combustion processes account for man's major emissions of carbon monoxide. Emissions from motor vehicles are especially significant because they occur near ground level and are concentrated in urban areas where the public may be exposed for long periods. Major industries and power generating plants normally provide adequate dispersion for their emissions to prevent unsatisfactory levels of carbon monoxide in ambient air.

The criteria for carbon monoxide are 30 ppm averaged for 1 hour and 13 ppm averaged for any consecutive 8-hour period. These criteria were established for the protection of human health and have not been exceeded in the past 4 years, based on monitoring at station 12008. Since this station is located in the downtown area of Windsor where the highest levels of carbon monoxide are expected, there is a high probability that levels were acceptable throughout the Windsor area.

A summary of data for carbon monoxide, obtained since 1972, is presented in Appendix 5, Table 9. Data obtained from 1972 to 1976 are higher than data for the last three years, attributable to a less accurate monitoring capability which was resolved with the installation of a more sophisticated monitor for carbon monoxide late in 1976.

OXIDES OF NITROGEN

Like many other pollutants, oxides of nitrogen are emitted into the atmosphere by man through combustion processes. Nitric oxide and nitrogen dioxide are the compounds of primary interest.

Criteria for desirable ambient air quality exist for nitrogen dioxide, but not for nitric oxide or total oxides of nitrogen. The criteria, which are based on the protection of human health and offensive odours, are 0.20 ppm averaged for 1 hour and 0.10 ppm averaged for 24 hours.

During 1979 the criteria were not exceeded. The annual average concentration of nitrogen dioxide was lower than in 1978 and the 1979 annual average of nitric oxide was the lowest since monitoring commenced in 1974. The data were determined by a continuous monitor located at station 12008 in downtown Windsor where emissions from motor vehicles would be concentrated. A summary of data for oxides of nitrogen is presented in Table 9, Appendix 5.

Although criteria for nitrogen dioxide were not exceeded during 1979 (in fact there has only been one excursion above the 1-hour criterion since monitoring commenced in 1973), oxides of nitrogen contribute to the formation of unsatisfactory levels of air pollution through their roles in the formation of photochemical oxidants. Therefore, consideration is being given to further controlling levels of oxides of nitrogen.

HYDROCARBONS

The principle man-made source of hydrocarbons is emissions from motor vehicles. Other significant man-made sources are incomplete combustion of fuels by industries and power plants and evaporation losses during the storage and transportation of hydrocarbons. Natural phenomena produce many hydrocarbons of which methane is the most abundant.

Owing to the wide range of effects associated with different hydrocarbons at various concentrations, no desir-

able ambient air criteria have been established for total hydrocarbons. Instead, control is achieved by setting criteria for desirable levels of specific hydrocarbons in ambient air and/or establishing standards which control the impact of emissions of specific hydrocarbons.

Although there are no criteria for total hydrocarbons, monitoring for them provides information on trends in levels of hydrocarbons. Increasing levels of hydrocarbons could be significant should they be attributable to detrimental compounds.

Total hydrocarbons are monitored continuously at station 12008 in downtown Windsor, using flame ionization detection. During 1979 only nine months of data were collected because of instrumentation problems. The annual average concentration for total hydrocarbons was lower in 1979 than any previous year since 1972, except 1974 when the annual average was the same as 1979, i.e. 1.9 ppm. A summary of the annual average concentrations contained in Table 9, Appendix 5, does not reveal any discernible trends in levels of total hydrocarbons. Levels are comparable to those measured in downtown areas of other cities.

OXIDANTS

Oxidants in the ambient air are primarily a result of a series of photochemical reactions and inter-reactions involving oxides of nitrogen and hydrocarbons. The reactions are promoted by certain meteorological conditions such as warm temperatures and intense sunshine with the result being higher levels of oxidants in the spring and summer months.

With ozone normally accounting for 80 to 90 percent of the oxidants present in ambient air and the tech-

nology for monitoring ozone being more accurate and efficient than that for total oxidants, most regulatory agencies, including this Ministry, monitor for ozone rather than total oxidants.

Long range transport of ozone and its precursor chemicals (oxides of nitrogen and hydrocarbons) can account for a very significant portion of local levels of ozone. Long-range transport from distances greater than 200 kilometres has been reported in the literature. Consequently, successful control of oxidants will depend on control strategies implemented in the United States as well as in Ontario.

Ozone is also present in the stratosphere where it plays the critical role of absorbing excessive amounts of ultraviolet solar radiation that may be biologically harmful. Occasionally, ozone from the stratosphere may be transported downward to cause elevated concentrations at the earth's surface. Ozone is naturally produced in minor amounts by lightning.

The criterion for desirable ambient air quality established for ozone is 80 parts per billion (ppb) averaged for 1 hour. This criterion was established for the protection of vegetation, property and human health. Some effects detrimental to health that are associated with oxidants are eye irritation and a decrease in performance during physical activities.

Ozone is monitored at station 12008, in downtown Windsor. During 1979 there were 62 hourly values above the 1-hour criterion, all of which occurred during the months of June through September. The frequency of ozone values exceeding the 1-hour criterion during 1979 was the lowest since 1974, when ozone monitoring began, and the frequency

of excursions was the same as 1979. Since the frequencies of excursions above the criterion are dependent on meteorological conditions, fluctations from year to year are expected. A summary of ozone data is presented in Appendix 5, Table 9. An investigation into the relationship between elevated levels of ozone and wind speed and direction during 1979 revealed that all the excursions are associated with winds from the south-east to south-west sector or, in a few cases, calm conditions. Similar findings have been reported for previous years. These findings are not surprising since southerly winds are apt to be associated with the backs of high pressure systems that have weather favourable for photochemical reactions (clear sunny skies and warmer temperatures) and that promote long-range transport of oxidants and its precursor chemicals from the United States. A pollution rose, associating the frequency of ozone values above 80 ppb with wind speed and direction, appears in Appendix 5, Figure 9.

In Ontario there has been no documentation of adverse health effects attributed to ozone encountered in the natural environment. However, there is extensive documentation of damage to vegetation, especially crops such as beans, tobacco and grapes.

FLUORIDES

Sources of fluorides in the Windsor area are the steel industry located in the downriver area of Wayne County, Michigan, power plants where the coal burned contains trace amounts of fluorides, fluorspar unloading operations at docks in west Windsor and subsequent trucking of fluorspar to a location south of Windsor.

Fluoridation rate is a measurement designed to indicate the relative amount of gaseous fluoride present over an extended period of time. A lime-impregnated filter is exposed to ambient air for thirty days and then analyzed for fluoride content. This monitoring technique measures primarily gaseous fluorides but some fluorides in particulate form are collected on the filter.

The criteria for desirable ambient air quality established for fluoridation rate are based on the protection of vegetation. Consequently, there is a criterion established for the growing season from April 15 to October 15 which is 40 micrograms of fluoride per 100 square centimetres of filter per 30 days (ug F/100 cm^2/30 days) as well as a criterion of 80 ug F/100 cm^2/30 days for the period of October 16 to April 14. Since the months of April and October are common to both criterion and fluoridation rate is determined on a monthly basis, excursions above the criteria during these months are determined by comparing the fluoridation rate to the average of the two criteria (60 ug F/100 cm^2/30 days).

During 1979 there were eight sites where fluoridation rates were monitored, 5 in west Windsor and 3 in the downtown area. Figure 10, Appendix 6 shows that higher annual averages for fluoridation rates and more frequent excursions above the criteria tend to occur in west Windsor. Table 10, Appendix 6, contains the 1979 fluoridation rate data. Although the criteria were periodically exceeded, phytotoxicology surveys revealed no vegetation damage attributable to fluorides in the Windsor area.

Although fluoridation rate is not considered a sensitive indicator of temporal trends of fluorides, it should be noted that based on six monitors operated from 1972, the annual averages for fluoridation rate and the frequency of excursions above the criteria were lowest in

1979. Also, with the exception of rates for 1977, there has been a continuous decrease in annual averages and frequencies of excursions during the past several years as depicted in Figure 11, Appendix 6.

APPENDIX 1

DESCRIPTION OF MONITORING NETWORK

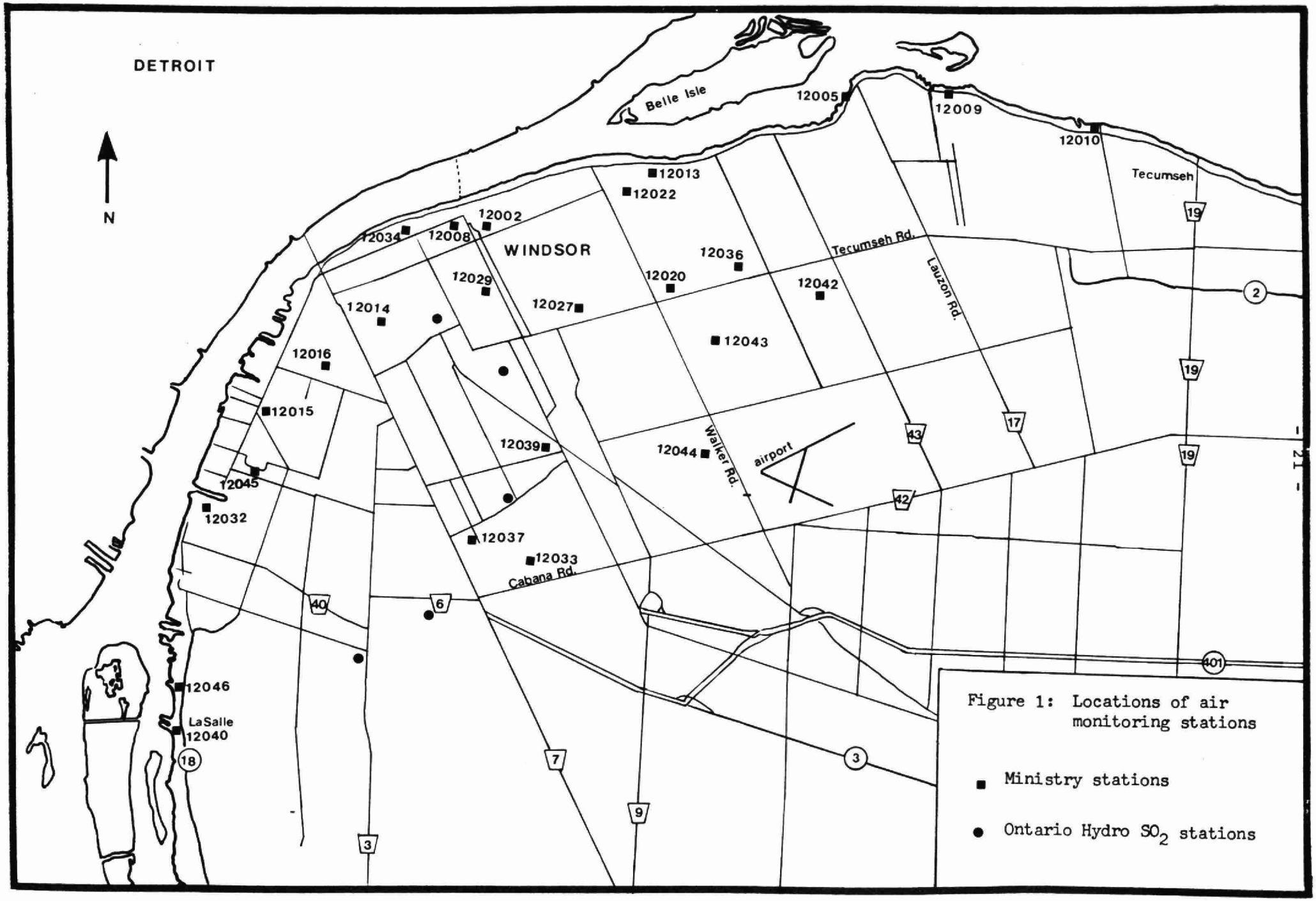

DETROIT
N
Belle Isle
12005
12009
12010
Tecumseh
12013
12022
12002
12034
12008
WINDSOR
12036
Tecumseh Rd.
12029
12020
12042
Lauzon Rd.
12014
12027
12043
12016
12015
12039
12044
Walker Rd.
airport
12045
12032
12037
12033
Cabana Rd.
12046
LaSalle
12040
401
Figure 1: Locations of air monitoring stations
Ministry stations
Ontario Hydro SO_2 stations

Table 1. Locations of air monitoring stations

Station number	Location	Universal transverse mercator projection co-ordinates	Elevation above sea level (metres)	Air intake height (metres)
12002	444 Windsor Avenue, City Hall	03323 - 46867	183	17
12005	7730 Riverside Drive East	03395 - 46890	177	10
12008	467 University Avenue	03316 - 46867	183	12
12009	Tecumseh Water Works	03413 - 46888	180	2
12010	Tecumseh Sewage Pumping Station	03460 - 46875	181	1
12013	3665 Wyandotte Street East	03358 - 46874	185	7 & 10
12014	College/California Street	03304 - 46849	185	1
12015	Highway No. 18/Prospect	03283 - 46833	175	6
12016	College/South Street	03290 - 46841	175	4
12020	1869 Albert Street	03363 - 46854	183	5
12022	Hickory/Richmond Street	03352 - 46870	183	5
12027	1526 Parent Street	03340 - 46852	183	5
12029	459 Ellis West	03323 - 46853	185	5
12032	Morton Dock	03271 - 46817	175	4, 7 & 30
12033	3501 Longfellow	03335 - 46801	183	5
12034	C. P. Telecommunication Tower	03308 - 46868	175	10 & 46
12036	1794 Westcott Street at Milloy Street	03367 - 46858	186	5
12037	3225 California Street (St. Hubert's School)	03327 - 46816	183	4
12039	Dougall St./E. C. Row W	03337 - 46821	195	5
12040	225 Willow Drive (La Salle)	03261 - 46773	175	5
12042	Princess/Joinville Street	03384 - 46848	185	5
12043	Somme/Chandler	03366 - 46845	183	5
12044	Seymour/Turner	03366 - 46822	183	5
12045	Healy/Sandwich	03276 - 46822	183	5
12046	Adams/Hwy 18	03264 - 46778	175	5

Table 2. Parameters monitored in the ambient air in Windsor during 1979

Station Number	Air Pollution Index	Carbon Monoxide	Dustfall	Fluoridation Rate	Hydrocarbons	Meteorological Data	Nitric Oxide	Nitrogen Dioxide	Nitrogen Oxides	Ozone	Soiling Index (1-hr COH)	Sulphur Dioxide	Suspended Particulate
12002			X										X
12005			X										X
12008	X	X	X	X	X		X	X	X	X	X	X	X
12009			X										X
12010			X										X
12013			X									X	X
12014			X										X
12015			X	X								X	X
12016	X		X	X							X	X	X
12020			X										
12022			X	X									
12027			X	X									
12029			X										
12032			X	X		X						X	X
12033			X										
12034						X							
12036													X
12037													X
12039													X
12040			X	X									
12042			X										
12043			X										
12044			X										
12045			X	X									
12046			X										

Table 3. Desirable ambient air quality criteria established by the Ontario Ministry of the Environment

Parameter	Desirable ambient air quality criteria	Prime reasons for establishing criteria or monitoring parameter
Carbon monoxide	30 ppm average for 1 hour	Protection of human health
	13 ppm averaged for 8 hours	Protection of human health
Dustfall	7 grams/metre^2 in 30 days	Historial and in keeping with other control agencies
	4.6 grams/metre^2 (monthly average in 1 year)	
Fluoridation rate	40 ug of fluorides/100 cm^2 of limed filter paper in 30 days during April 15 to October 15	Protection of vegetation
	80 ug of fluorides/100 cm^2 of limed filter paper in 30 days during October 16 to April 14	Protection of vegetation (less restrictive criterion during the non-growing season)
Hydrocarbons (total)	None	Effects of hydrocarbons vary widely depending on their chemical-physical nature
Nitric oxide	None	Reacts with oxygen to produce NO_2
Nitrogen dioxide	0.20 ppm average for 1 hour	Protection of human health and protection against odours
	0.10 ppm average for 24 hours	Protection of human health and protection against odours
Oxides of nitrogen	None	

Table 3. continued

Parameter	Desirable ambient air quality criteria	Prime reasons for establishing criteria or monitoring parameter
Ozone	0.08 ppm averaged for 1 hour	Protection of vegetation and human health
Sulphur dioxide	0.25 ppm average for 1 hour	Protection of vegetation
	0.10 ppm averaged 1 day (24 hours)	Protection of human health
	0.02 ppm averaged for 1 year	Protection of vegetation
Suspended particulates	120 ug/m^3 averaged for 24 hours	Based on impairment of visibility and health effects
	60 ug/m^3 (geometric mean) during 1 year	Based on public awareness of visible pollution
Cadmium in suspended particulates	2.0 ug/m^3 averaged for 24 hours	Based on protection of human health
Lead in suspended particulates	5.0 ug/m^3 averaged for 24 hours	Based on protection of human health
	2.0 ug/m^3 as a geometric mean over a 30 day period	Based on protection of human health
Nickel in suspended particulates	2.0 ug/m^3 averaged for 24 hours	Based on protection of vegetation
Vanadium in suspended particulates	2.0 ug/m^3 averaged for 24 hours	Based on protection of human health

APPENDIX 2

METEOROLOGICAL DATA

Table 4. Summary of data for percent frequencies of wind direction

Site and year	Wind directions							
	North	North-east	East	South-east	South	South-west	West	North-west
Station 12032: 30-metre level								
1972	9.0	11.2	11.3	8.6	15.9	15.0	14.7	14.3
1973	13.0	10.7	11.2	7.8	11.8	19.2	13.9	12.3
1974	7.3	10.3	8.5	7.0	22.5	16.7	14.6	13.0
1975	6.8	10.6	10.6	8.1	16.6	19.4	15.6	12.3
1976	9.7	8.8	8.3	7.2	14.5	16.2	20.2	15.1
1977	8.8	10.1	8.6	9.9	16.4	20.8	16.0	9.5
1979	5.5	8.5	10.8	9.4	17.5	20.6	12.9	14.7
Station 12034: 46-metre level								
1978	8.7	17.8	7.8	5.7	12.8	19.5	14.0	13.8

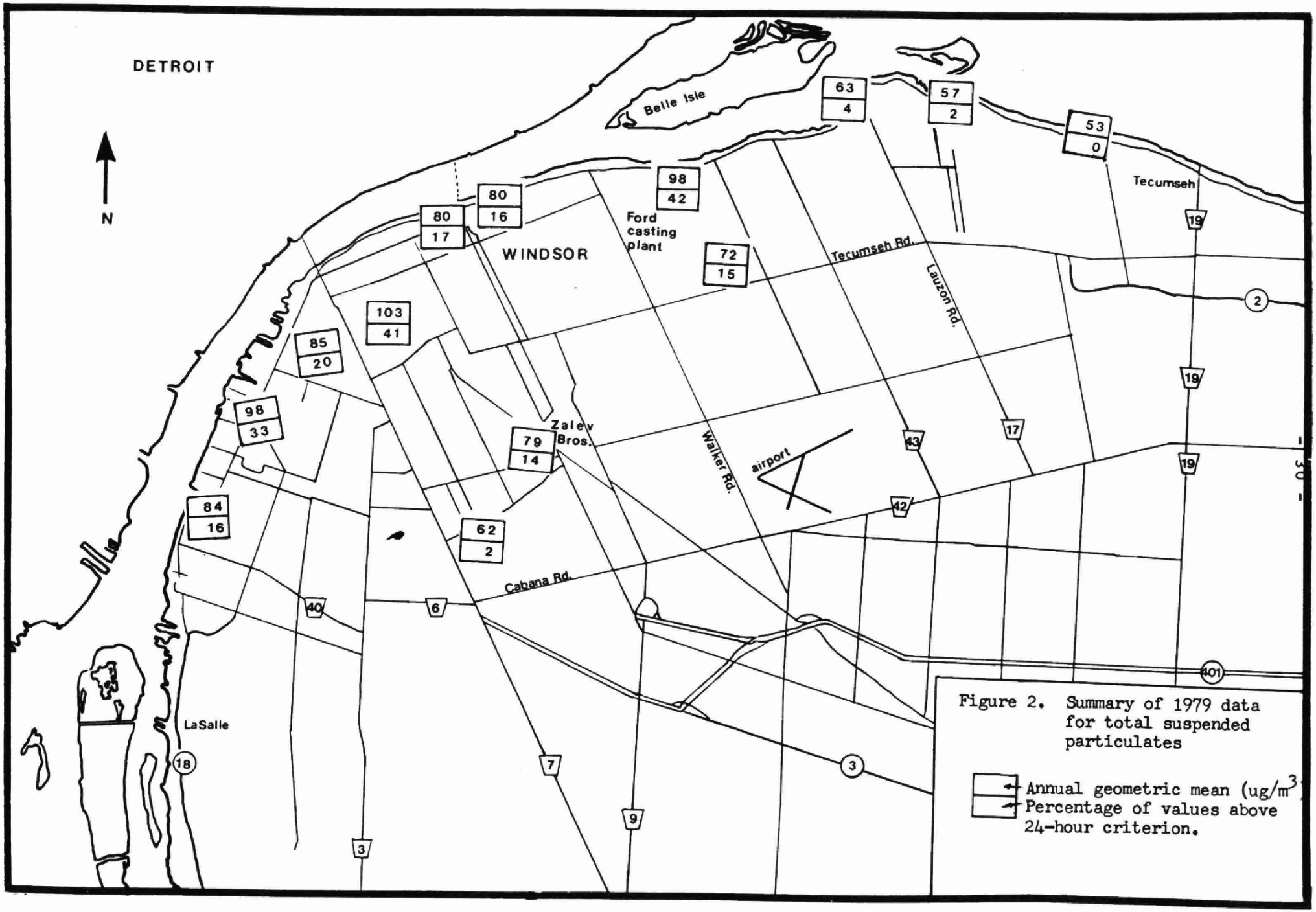
APPENDIX 3

PARTICULATES

Table 5. Summary of data for total suspended particulates.

Station	Year							
	1972	1973	1974	1975	1976	1977	1978	1979
	Annual geometric means (ug/m³)							
12002	159	133	108	74	76	82	79	80
12005							I.D.	63
12008	126	126	116	82	80	87	80	80
12009	79	82	61	52	58	54	52	57
12010	85	86	58	46	54	47	46	53
12013	151	145	113	89	98	113	100	98
12014	152	148	139	95	94	96	77	103
12015	183	147	152	105	113	93	93	98
12016				88	88	95	84	85
12032	126	120	94	81	89	93	79	84
12036						72	63	72
12037						67	68	62
12039								79
	Percentage of values above 24-hour criterion							
12002	70	58	43	14	15	21	18	16
12005							4	4
12008	57	55	47	17	19	24	16	17
12009	16	25	10	2	5	7	9	4
12010	23	27	17	2	10	6	7	0
12013	65	69	44	26	37	40	40	42
12014	70	72	64	25	26	26	20	41
12015	80	66	84	33	42	25	27	33
12016				20	24	22	23	20
12032	53	53	30	21	27	25	19	16
12036						11	9	15
12037						10	15	2
12039								14

I.D. - Insufficient data to compute a representative geometric mean.


DETROIT
N
Belle Isle
63
4
57
2
53
0
Tecumseh
19
98
42
80
16
80
17
Ford
casting
plant
WINDSOR
72
15
Tecumseh Rd.
Lauzon Rd.
2
103
41
85
20
98
33
Zalev
Bros.
79
14
Walker Rd.
airport
43
17
19
19
84
16
62
2
42
Cabana Rd.
40
6
LaSalle
18
7
3
9
3
401
Figure 2. Summary of 1979 data for total suspended particulates
Annual geometric mean (ug/m3)
Percentage of values above 24-hour criterion.

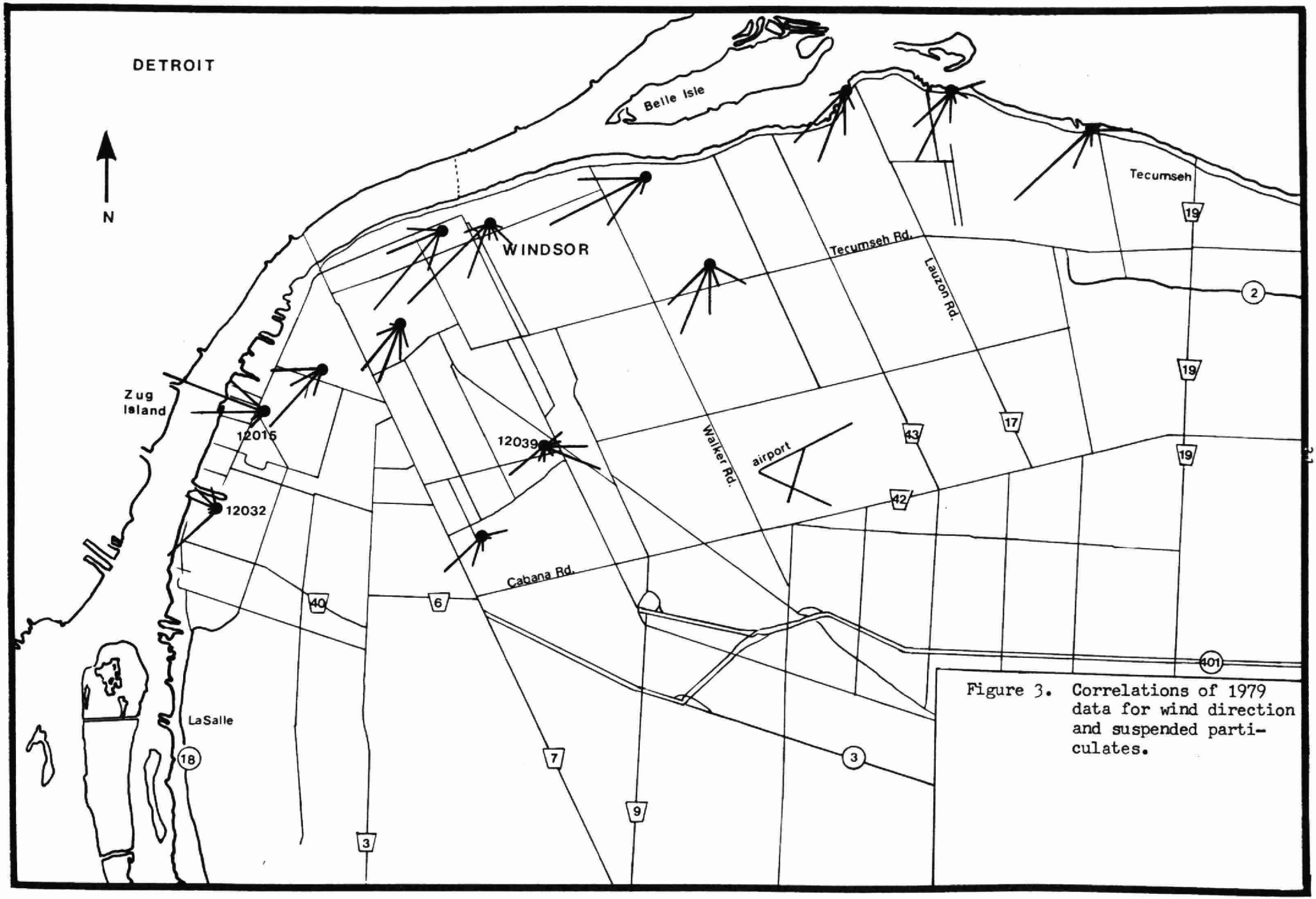
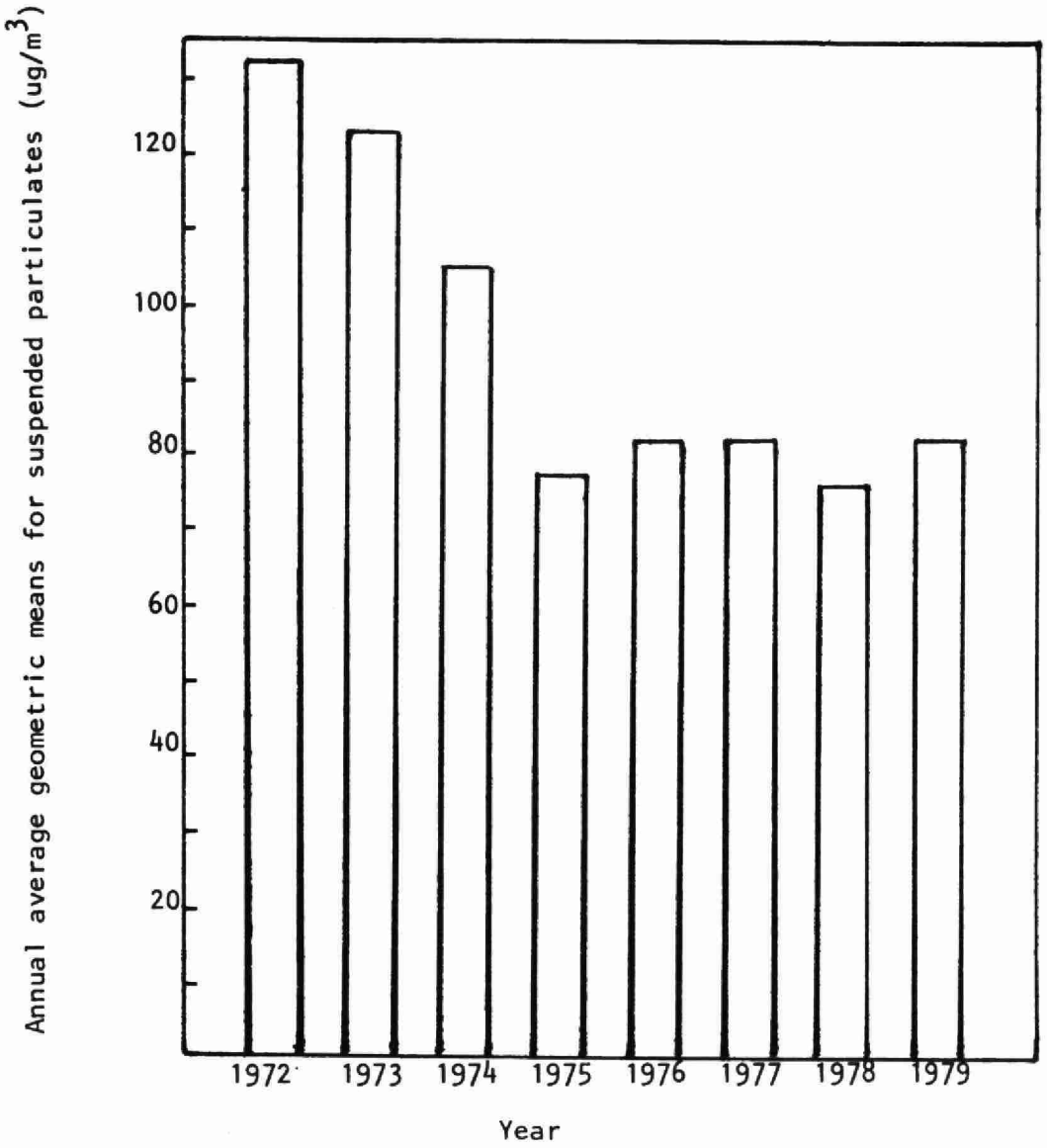


Figure 3. Correlations of 1979 data for wind direction and suspended particulates.

Figure 4. Trend in levels of suspended particulates based on averaged data from eight monitoring stations.



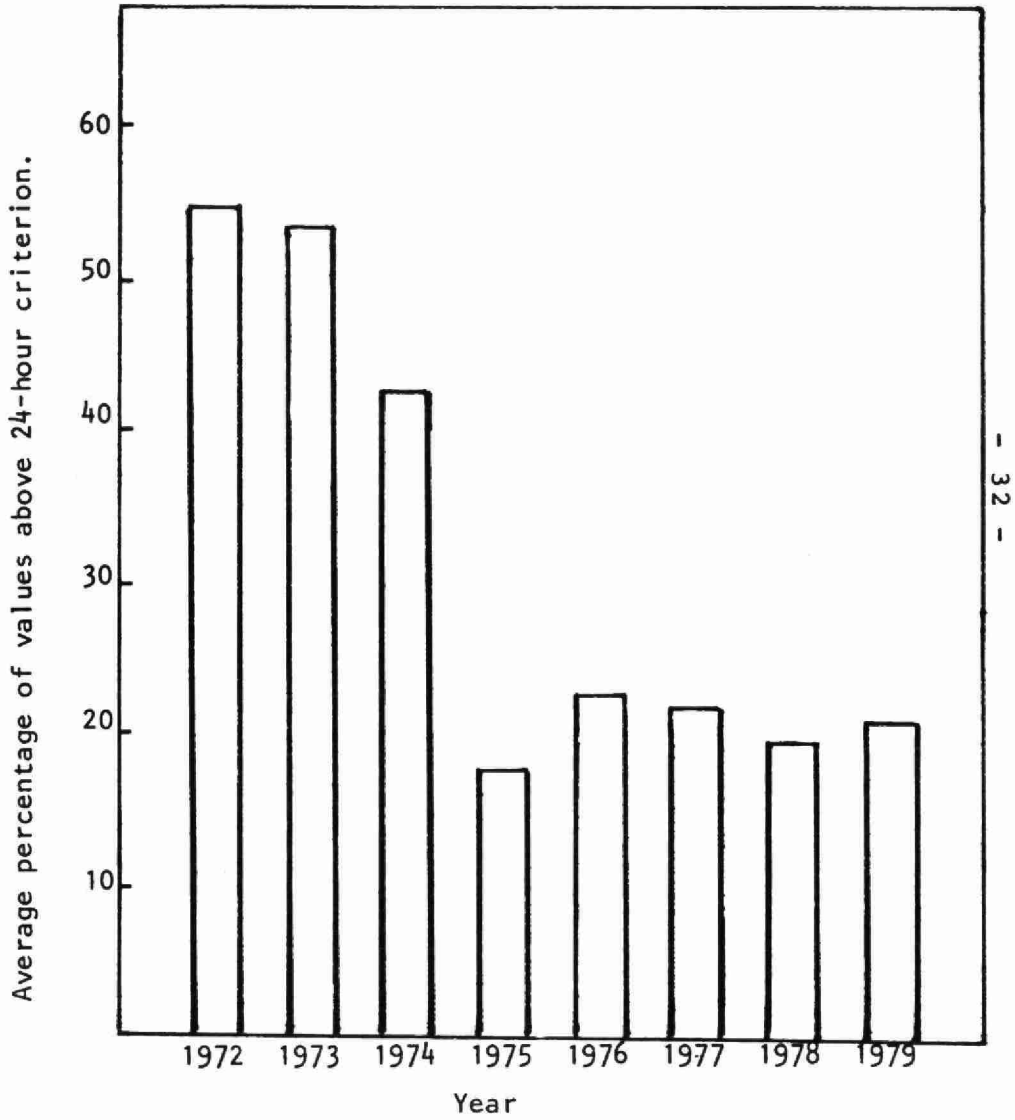


Table 6. Summary of constituents in suspended particulate matter (ug/m³)

Station and Year	Cadmium # of samples	Cadmium Avg.	Cadmium Max.	Chromium # of samples	Chromium Avg.	Chromium Max	Copper # of samples	Copper Avg.	Copper Max	Iron # of samples	Iron Avg.	Iron Max	Lead # of samples	Lead Avg.	Lead Max
12002															
1976	12	0.002	0.010	12	0.006	0.022	12	0.10	0.36	12	3.3	8.2	12	0.7	1.1
1977	20	0.006	0.016	20	0.031	0.062	20	0.15	0.52	20	3.0	8.4	21.	0.7	1.3
1978	24	0.007	0.035	24	0.018	0.045	24	0.23	0.62	24	3.1	9.9	24	0.6	1.2
1979	28	0.004	0.020	28	0.009	0.026	28	0.08	0.20	27	2.0	5.9	49	0.4	1.0
12008															
1976	15	0.000	0.003	15	0.012	0.029	15	0.25	0.45	15	3.2	6.9	15	0.6	1.3
1977	18	0.007	0.025	18	0.017	0.074	18	0.42	1.07	18	3.9	11.1	18	0.8	1.7
1978	23	0.004	0.019	23	0.017	0.045	23	1.13	2.55	23	2.8	7.8	23	0.6	1.8
1979	34	0.004	0.023	34	0.008	0.036	34	0.49	1.62	34	2.1	6.3	34	0.4	1.0
12009															
1979													48	0.2	2.4
12010															
1976	12	0.001	0.006	12	0.007	0.026	12	0.12	0.31	12	1.6	5.2	12	0.3	1.0
1977	20	0.001	0.006	20	0.009	0.029	20	0.08	0.24	20	1.1	5.5	20	0.3	0.9
1978	24	0.002	0.007	24	0.007	0.020	24	0.13	0.44	24	1.0	2.5	24	0.3	1.2
1979	32	0.002	0.005	32	0.003	0.015	32	0.19	0.79	32	0.9	2.1	32	0.2	0.6
12013															
1976	17	0.006	0.035	17	0.028	0.113	17	0.14	0.28	22	5.7	21.9	17	0.6	2.0
1977	19	0.007	0.033	19	0.032	0.101	19	0.14	0.35	24	7.2	26.3	19	0.7	1.8
1978	23	0.003	0.012	23	0.032	0.116	23	0.09	0.26	57	5.7	20.6	23	0.5	1.0
1979	22	0.002	0.009	22	0.016	0.055	22	0.13	0.60	56	5.4	29.5	22	0.4	0.9
12014															
1978										47	2.7	8.2			
1979										52	2.9	8.3			
12015															
1978										55	4.0	15.4			
1979										48	3.9	11.3			

Table 6. Summary of constituents in suspended particulate matter (ug/m³)

Station and Year	Cadmium # of samples	Cadmium Avg.	Cadmium Max.	Chromium # of samples	Chromium Avg.	Chromium Max	Copper # of samples	Copper Avg.	Copper Max	Iron # of samples	Iron Avg.	Iron Max	Lead # of samples	Lead Avg.	Lead Max
12016															
1978										56	3.8	12.5			
1979										52	3.1	10.1			
12032															
1976	15	0.004	0.011	15	0.012	0.028	15	0.10	0.37	40	4.1	8.4	15	0.4	1.3
1977	26	0.002	0.009	26	0.015	0.048	26	0.34	1.13	29	3.5	17.9	26	0.4	0.9
1978	24	0.003	0.012	24	0.021	0.056	24	0.14	1.00	52	2.9	9.6	24	0.4	0.9
1979	17	0.004	0.017	17	0.008	0.024	17	0.03	0.09	43	3.5	9.6	58	0.3	1.4
12039															
1979										56	3.4	24.6			

Table 6. Summary of constituents in suspended particulate matter (ug/m³)

Station and Year	Manganese # of samples	Manganese Avg.	Manganese Max.	Nickel # of samples	Nickel Avg.	Nickel Max	Nitrate # of samples	Nitrate Avg.	Nitrate Max	Sulphate # of samples	Sulphate Avg.	Sulphate Max	Vanadium # of samples	Vanadium Avg.	Vanadium Max
12002															
1976	12	0.12	0.22	12	0.012	0.027	54	4.9	11.8	54	9.4	35.1	12	0.02	0.03
1977	20	0.10	0.32	20	0.025	0.073	56	4.8	21.6	56	12.4	35.5	20	0.03	0.14
1978	24	0.14	1.10	24	0.016	0.034	52	6.2	20.5	52	14.0	41.1	24	0.00	0.02
1979	28	0.08	0.20	28	0.009	0.015	49	6.8	17.8	49	13.4	28.4	28	0.00	0.03
12008															
1976	15	0.11	0.28	15	0.050	0.409	105	4.8	21.6	104	10.6	39.7	15	0.17	1.47
1977	18	0.19	0.48	18	0.026	0.084	48	5.1	23.5	48	13.3	34.2	18	0.02	0.10
1978	23	0.11	0.31	23	0.026	0.059	55	5.3	20.5	55	14.3	57.1	23	0.00	0.03
1979	34	0.07	0.22	34	0.011	0.027	58	5.9	15.7	58	13.7	40.5	34	0.00	0.01
12009															
1979							24	5.2	13.4	24	11.7	25.4			
12010															
1976	12	0.05	0.19	12	0.003	0.021	51	3.5	14.2	51	6.9	31.9	12	0.00	0.01
1977	20	0.03	0.20	20	0.019	0.035	52	4.3	24.5	52	10.3	25.4	20	0.00	0.02
1978	24	0.03	0.09	24	0.008	0.019	55	4.5	25.2	55	11.5	44.1	24	0.00	0.00
1979	32	0.03	0.07	32	0.005	0.011	54	5.1	12.6	54	11.5	30.3	32	0.00	0.02
12013															
1976	17	0.38	1.94	17	0.004	0.029	59	4.4	15.0	59	8.2	21.0	17	0.00	0.02
1977	19	0.39	2.02	19	0.030	0.069	64	6.1	32.0	54	13.0	33.6	19	0.01	0.07
1978	23	0.24	0.95	23	0.013	0.058	56	6.5	22.8	56	14.7	48.4	23	0.00	0.03
1979	22	0.15	0.38	22	0.011	0.025	56	7.1	22.9	56	14.9	41.9	22	0.00	0.01
12032															
1976	15	0.14	0.22	15	0.001	0.005	65	5.1	31.3	65	10.9	55.6	15	0.01	0.03
1977	26	0.11	0.62	26	0.015	0.060	61	6.2	32.0	61	15.2	35.0	26	0.01	0.06
1978	24	0.13	0.44	24	0.008	0.031	50	5.1	17.8	50	13.5	45.3	24	0.00	0.03
1979	17	0.13	0.31	17	0.006	0.014	57	5.7	13.3	57	13.9	27.5	17	0.00	0.02

Table 7. Levels of dustfall during 1979

Station Number	Dustfall loading ($g/m^2/30$ days)												Annual Average	Percentage of values above monthly criterion
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec		
12002	2.4	2.7	9.6	6.6	5.5			3.2	3.7	4.3	4.1	2.9	4.5	10
12005	2.0	3.5	3.6	5.0	4.8	4.1	3.6		4.1	2.5	2.8	2.0	3.5	0
12008	3.1	4.5	9.4	6.6	7.9	7.5	6.0	4.7	6.1	4.7	5.1	3.8	5.8	25
12009	1.4	1.7	3.4	5.0	5.5	4.3	10.7	5.0	2.9	2.7	2.9	3.7	4.1	8
12010	1.3	1.4	2.8	7.2	6.4				9.6	3.9	3.1	1.4	4.1	22
12013	5.1	3.7	8.0	12.3	8.1	7.0	7.5	7.5	5.0	6.8	8.9	5.6	7.1	50
12014	5.1	5.3	8.4	9.2	11.8	6.8	7.2	6.2	6.0	5.9	8.1	6.2	7.2	42
12015	8.8	5.9	9.5	13.3	8.9			7.6	9.5	6.1	10.0	7.4	8.7	80
12016	3.4	3.4	4.5	7.4	7.7	5.7	6.7	4.4	4.6	4.1	5.1	3.8	5.1	17
12020	2.6	3.2	5.0	7.4	5.7	5.0	6.1	5.5	4.6	4.0	6.3	4.6	5.0	8
12022	4.3	5.6	12.6	7.8	11.5	9.1	15.0	8.1	8.6	6.7	7.2	5.3	8.5	67
12027	5.0	7.9	13.9	13.8	10.7	9.1	10.3	6.6	6.6	6.1	9.0	7.1	8.8	67
12029	1.7	3.0	5.8	10.8	7.9	6.6	5.9	4.7	6.6	4.5	7.6	3.2	5.7	25
12032	4.7	4.5	3.4	8.4	6.5	9.9	7.8	9.6	4.6	5.6	6.2	4.0	6.3	33
12033	2.4	2.1	4.5	15.2	11.5	3.7	9.2	4.3	5.2	5.0	6.3	3.2	6.1	25
12040	3.3	4.4	5.8	9.2	9.4	7.5	7.3	3.9	5.8	6.9	4.8	1.9	5.9	33
12042	2.6	3.0	5.2	4.7	8.1	5.1	10.3	3.9	7.6	2.9	5.1	5.2	5.3	25
12043	2.4	2.2	5.0	5.3	5.1	4.5	5.6	3.5	4.0	3.4	3.8	2.7	3.9	0
12044	2.0	2.7	5.4	5.9	6.5	5.0	5.8	4.3	5.6	3.7	3.3	1.9	4.3	0
12045	7.6	3.7	5.2	11.7	7.4	6.9	10.4	7.7	8.1	6.8	4.3	5.0	7.1	50
12046	5.0	4.9	6.7	5.9	8.7	10.3	18.4	11.2	6.7	4.5	5.9	4.3	7.7	33

NOTE: Underlined values exceed 30-day or annual criteria.

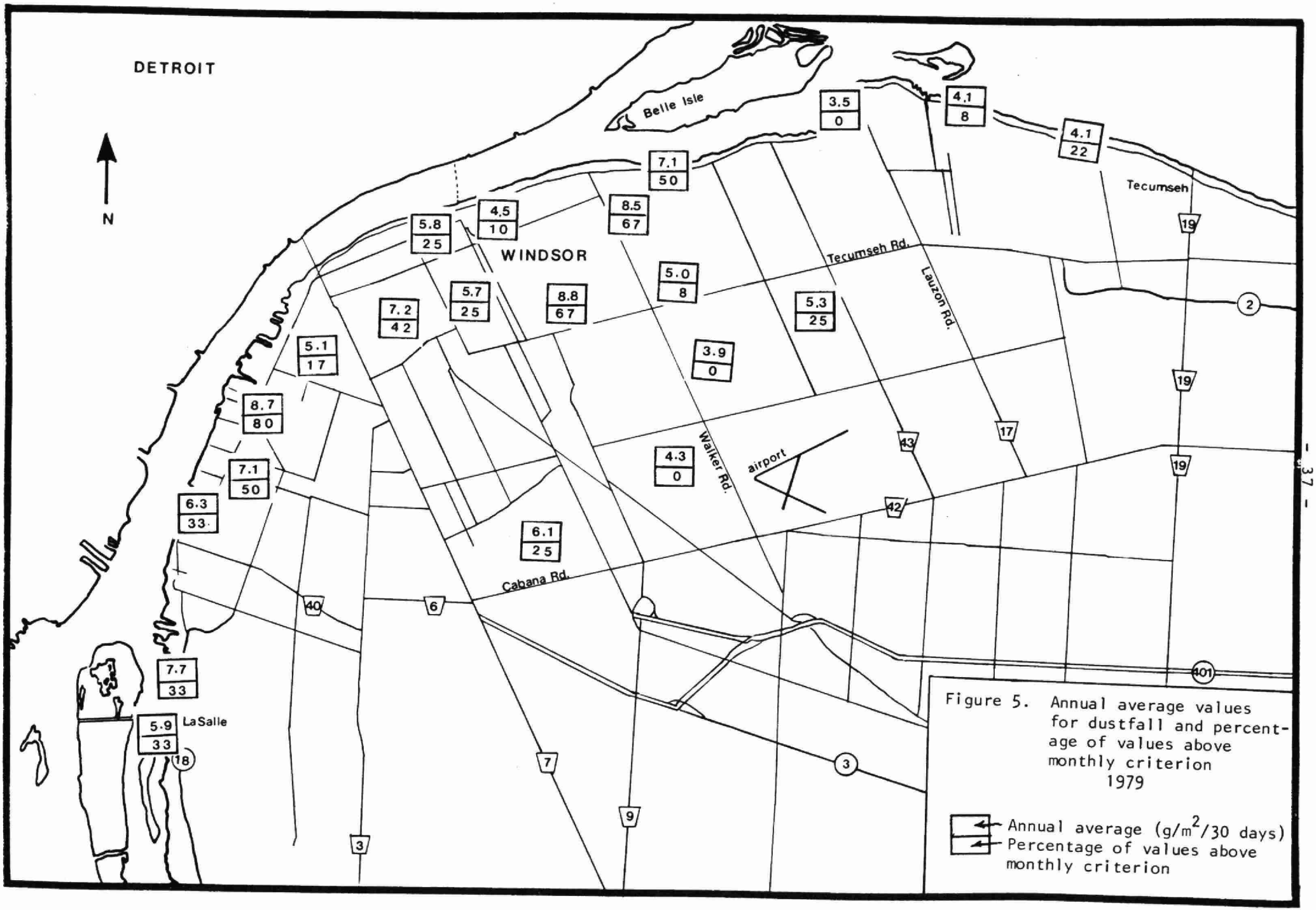
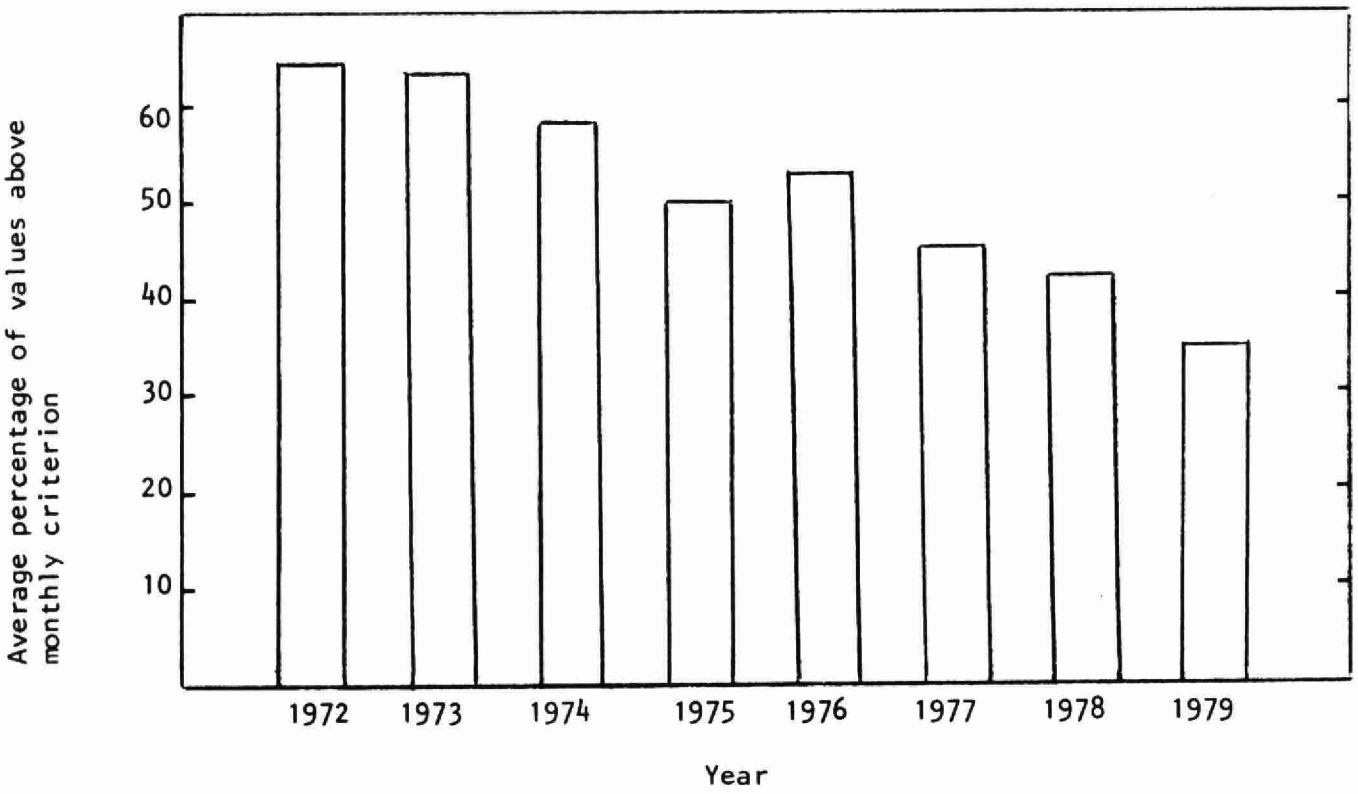
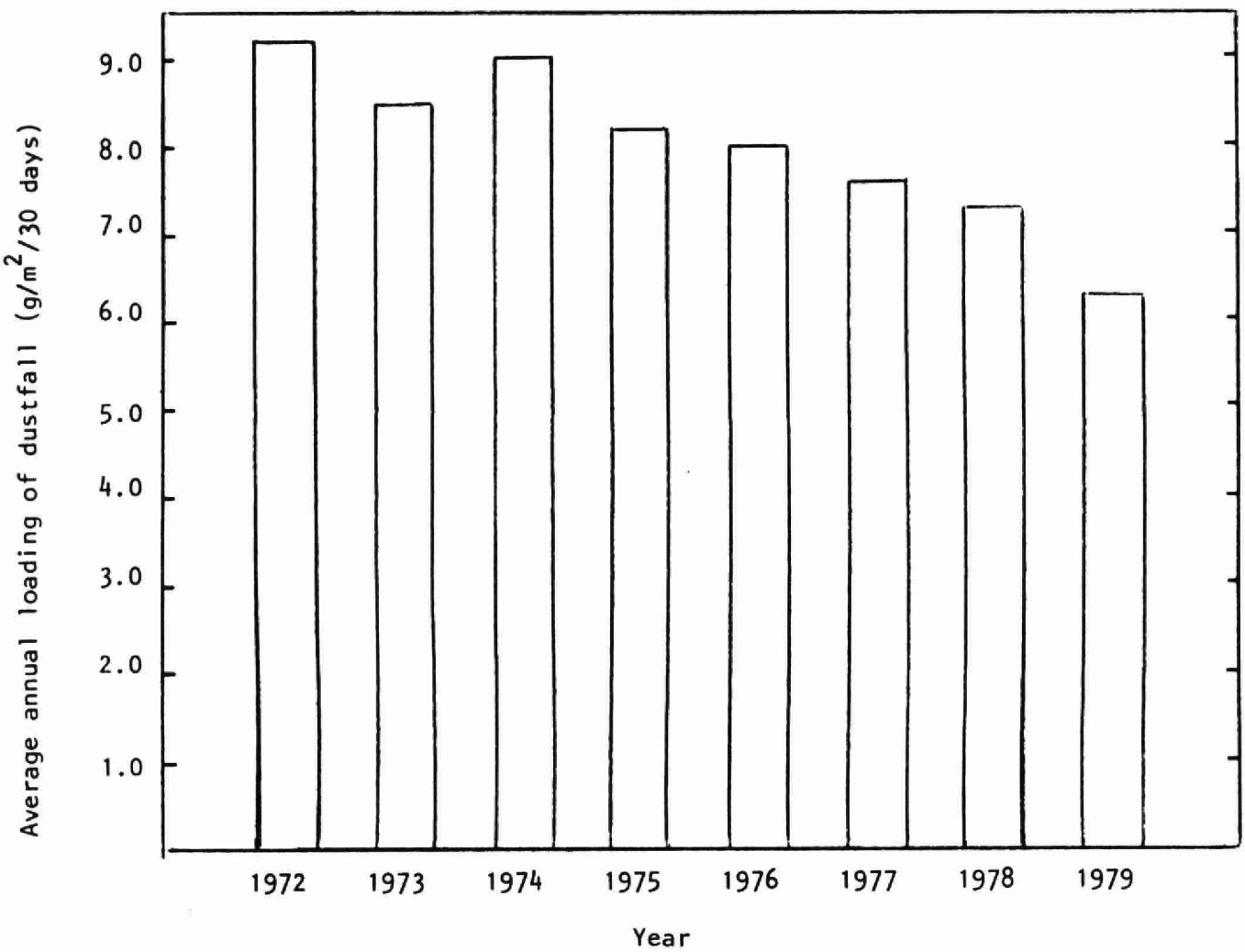


Figure 5. Annual average values for dustfall and percentage of values above monthly criterion 1979

Figure 6. Trend in dustfall levels based on averaged data for fourteen monitoring stations.





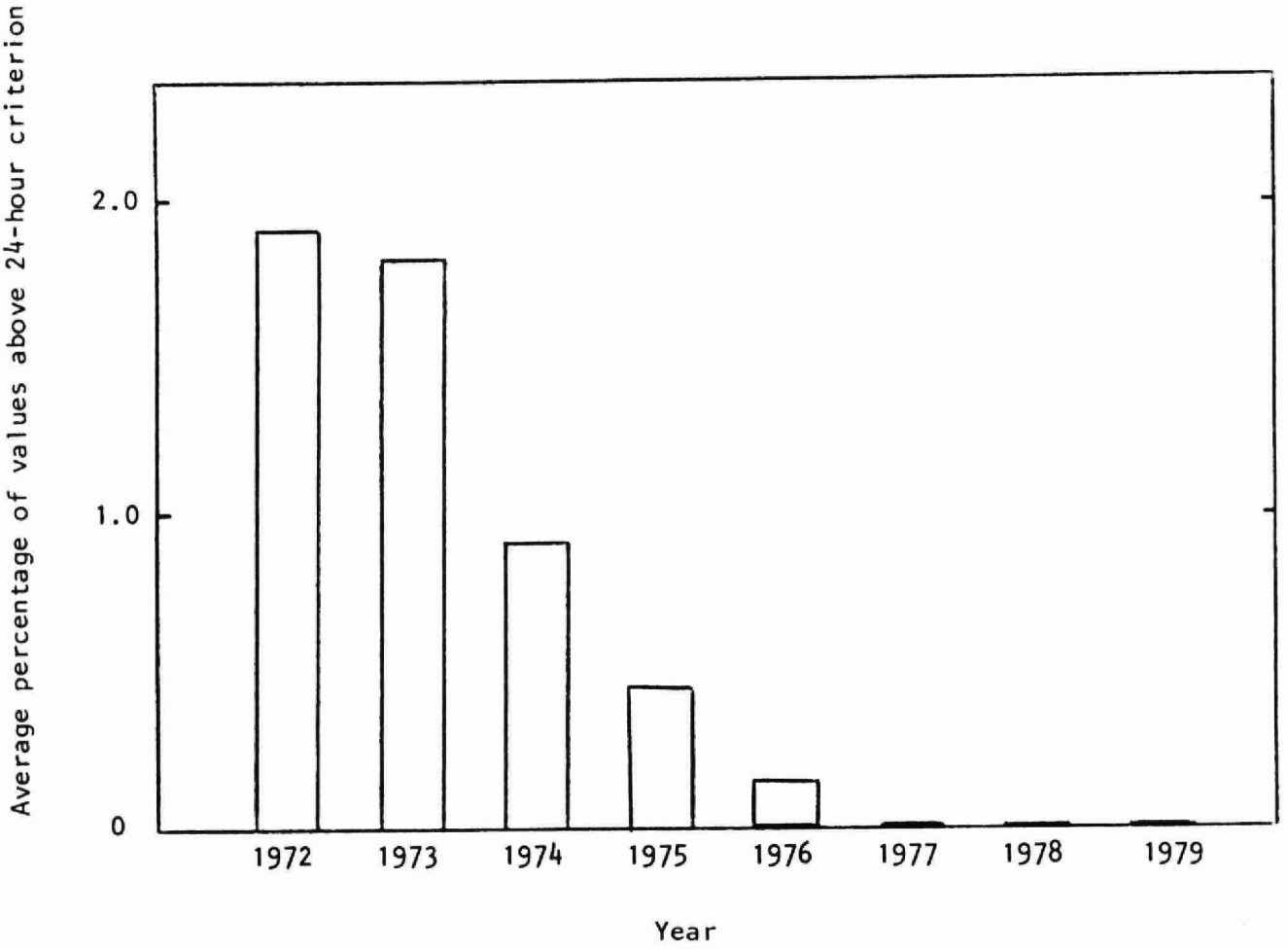
APPENDIX 4

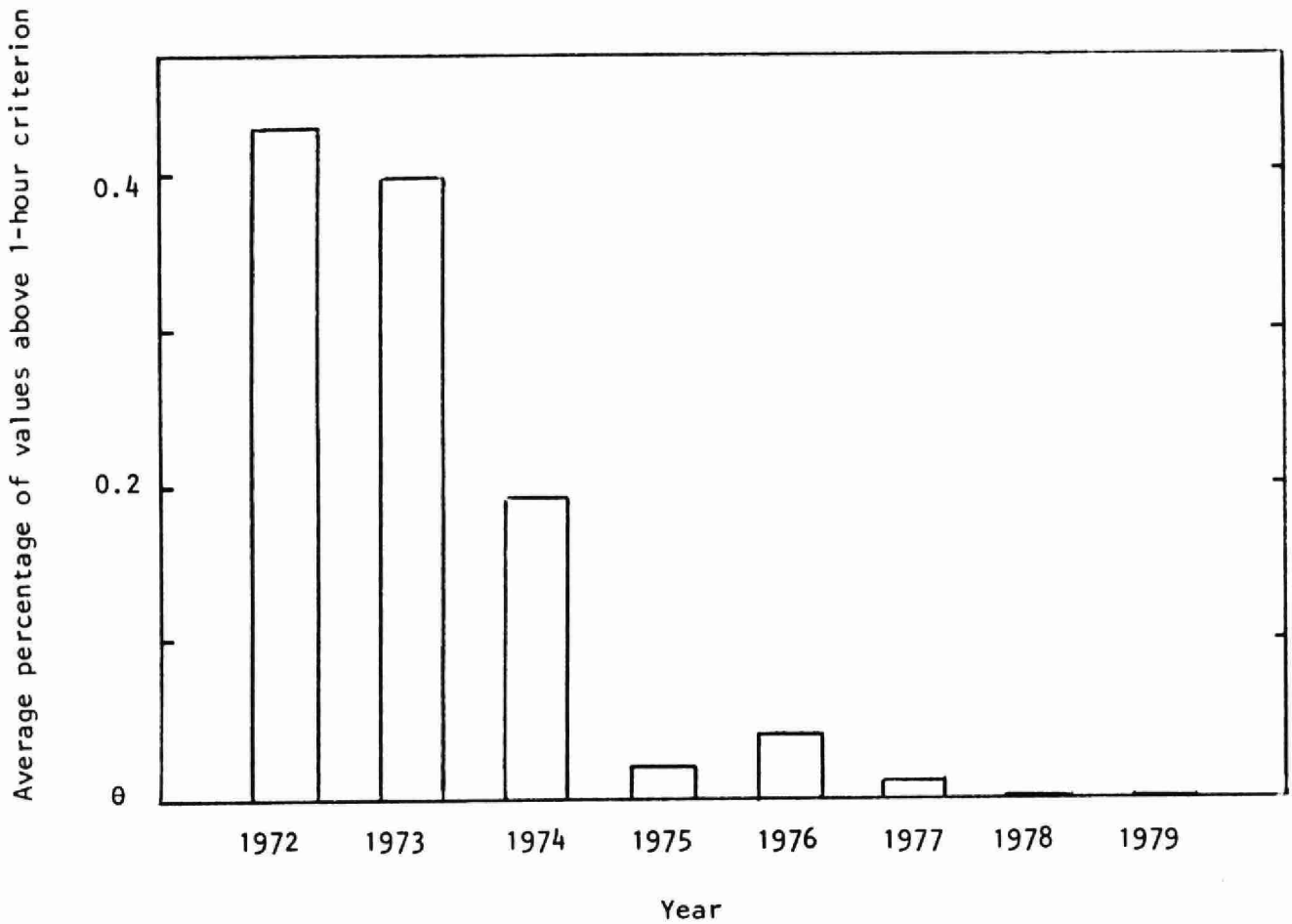
SULPHUR OXIDES

Table 8. Summary of 1979 data for sulphur dioxide

Parameter	Station number				
	12008	12013	12015	12016	12032
Annual average (ppm)	0.01	0.00	0.01	0.02	0.02
Percentage of values greater than:					
1-hour criterion	0	0	0	0	0
24-hour criterion	0	0	0	0	0
Highest 1-hour value (ppm)	0.13	0.08	0.17	0.18	0.14
Highest 24-hour value (ppm)	0.07	0.02	0.07	0.08	0.05

Figure 7. Trend in frequencies of excursions for sulphur dioxide based on combined data from stations 12008 and 12032





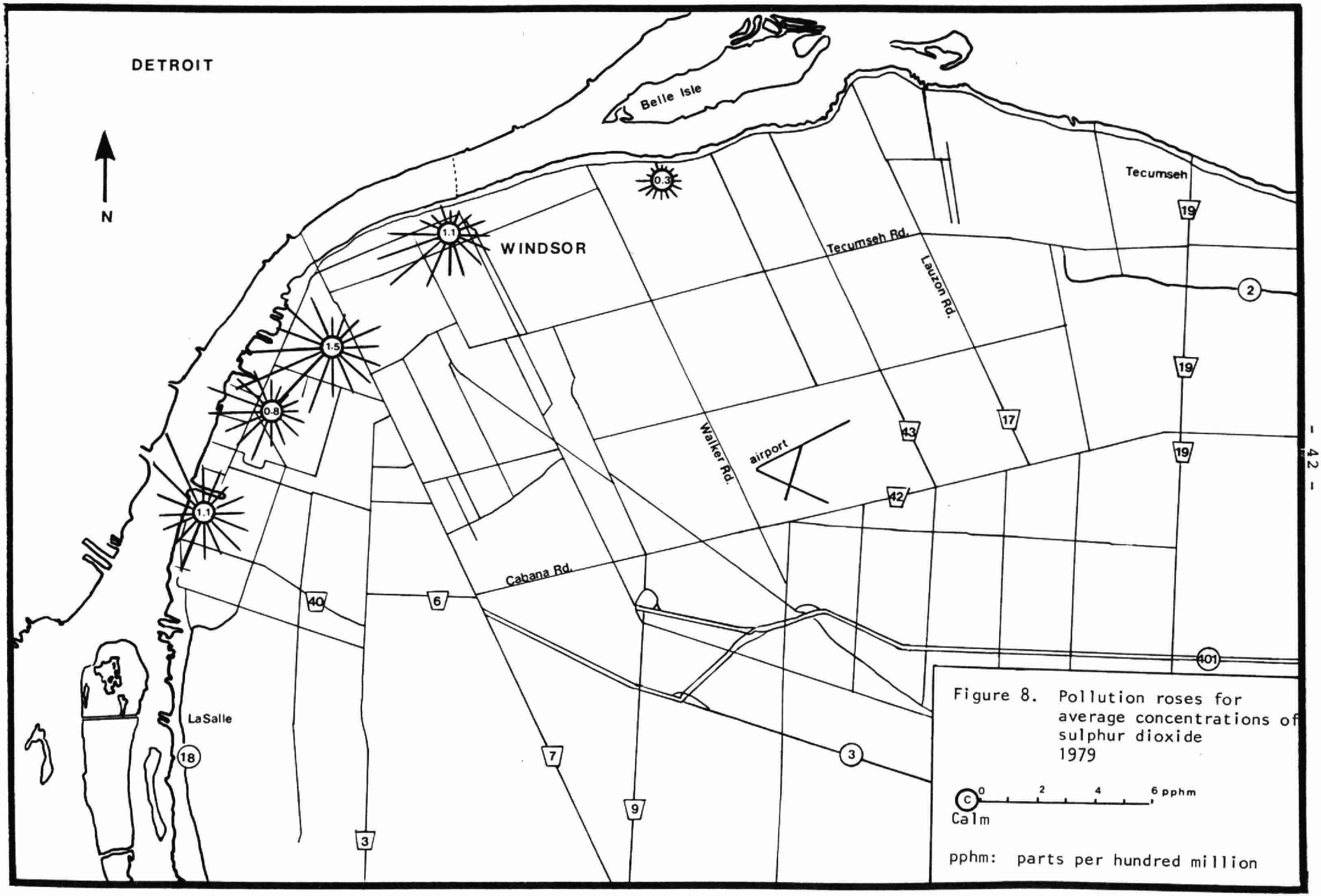


Figure 8. Pollution roses for average concentrations of sulphur dioxide 1979

C Calm 0 2 4 6 pphm

pphm: parts per hundred million

APPENDIX 5

CARBON MONOXIDE, OXIDES OF NITROGEN

TOTAL HYDROCARBONS AND OZONE

Table 9. Summary of data for carbon monoxide, oxides of nitrogen, total hydrocarbons and ozone.

Parameter	1979	1978	1977	1976	1975	1974	1973	1972
Carbon monoxide								
Annual average (ppm)	2	2	2	4	5	5	5	5
Percentage of values greater than:								
1-hour criterion	0	0	0	0	0	0	0.01	0
8-hour criterion	0	0	0	0	0.32	0.30	0.10	0
Nitrogen Dioxide								
Annual average (ppm)	0.03	0.04	0.03	0.03	0.03	0.03		
Percentage of values greater than:								
1-hour criterion	0	0.01	0	0	0	0		
24-hour criterion	0	0	0	0	0	0		
Nitric oxide								
Annual average (ppm)	0.02	0.03	0.03	0.03	0.03	0.04		
Total oxides of nitrogen								
Annual average (ppm)	0.05	0.07	0.07	0.06	0.06	0.07		
Total hydrocarbons								
Annual average (ppm)	1.9[(a)]	2.3	2.4	2.6	2.2	1.9	2.1	2.2
Ozone								
Annual average (ppm)	0.016	0.018	0.021	0.021	0.017	0.014		
Percentage of values greater than:								
1-hour criterion	0.8	2.4	3.1	2.5	2.2	0.8		

(a) 9 months of data

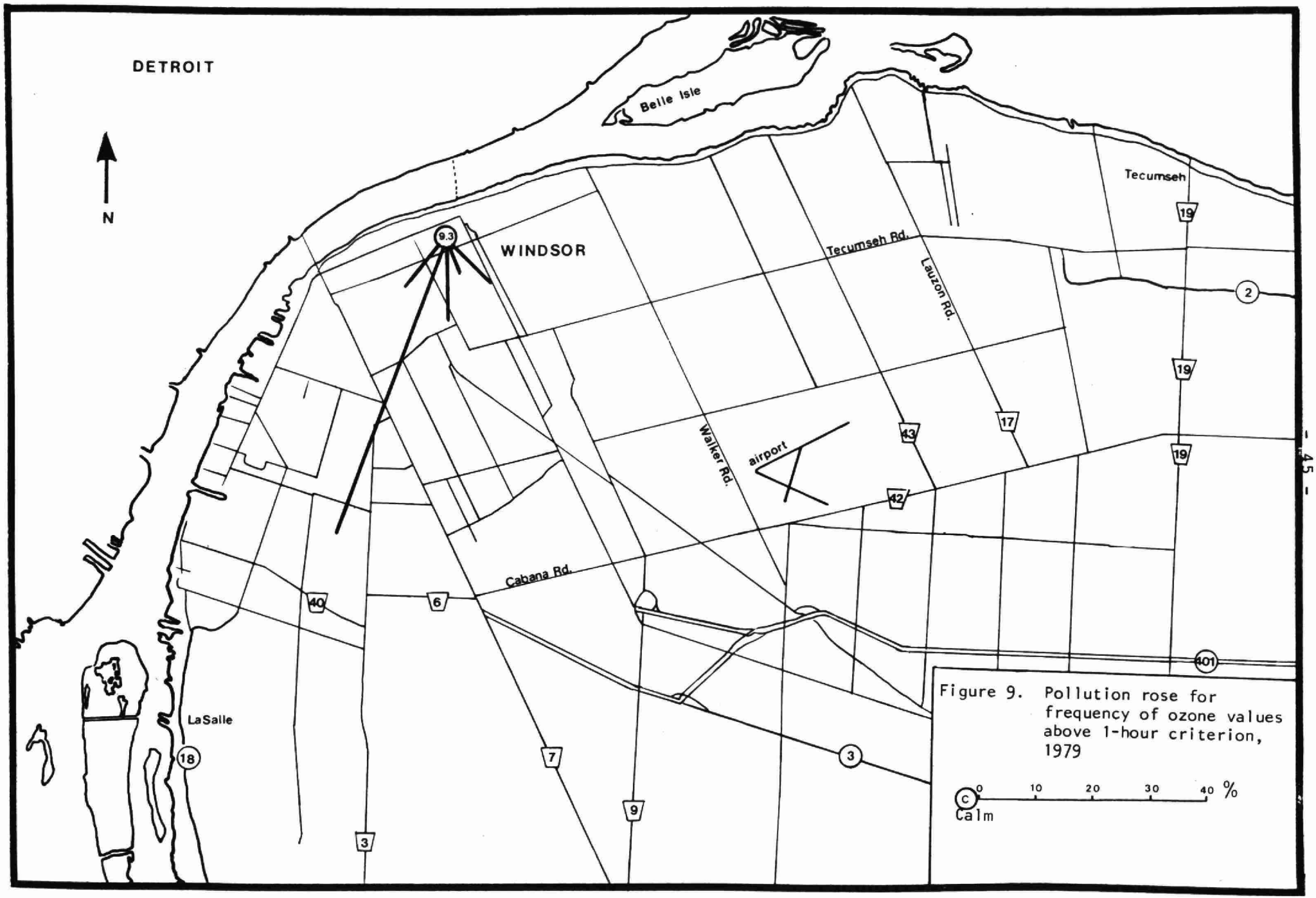


Figure 9. Pollution rose for frequency of ozone values above 1-hour criterion, 1979

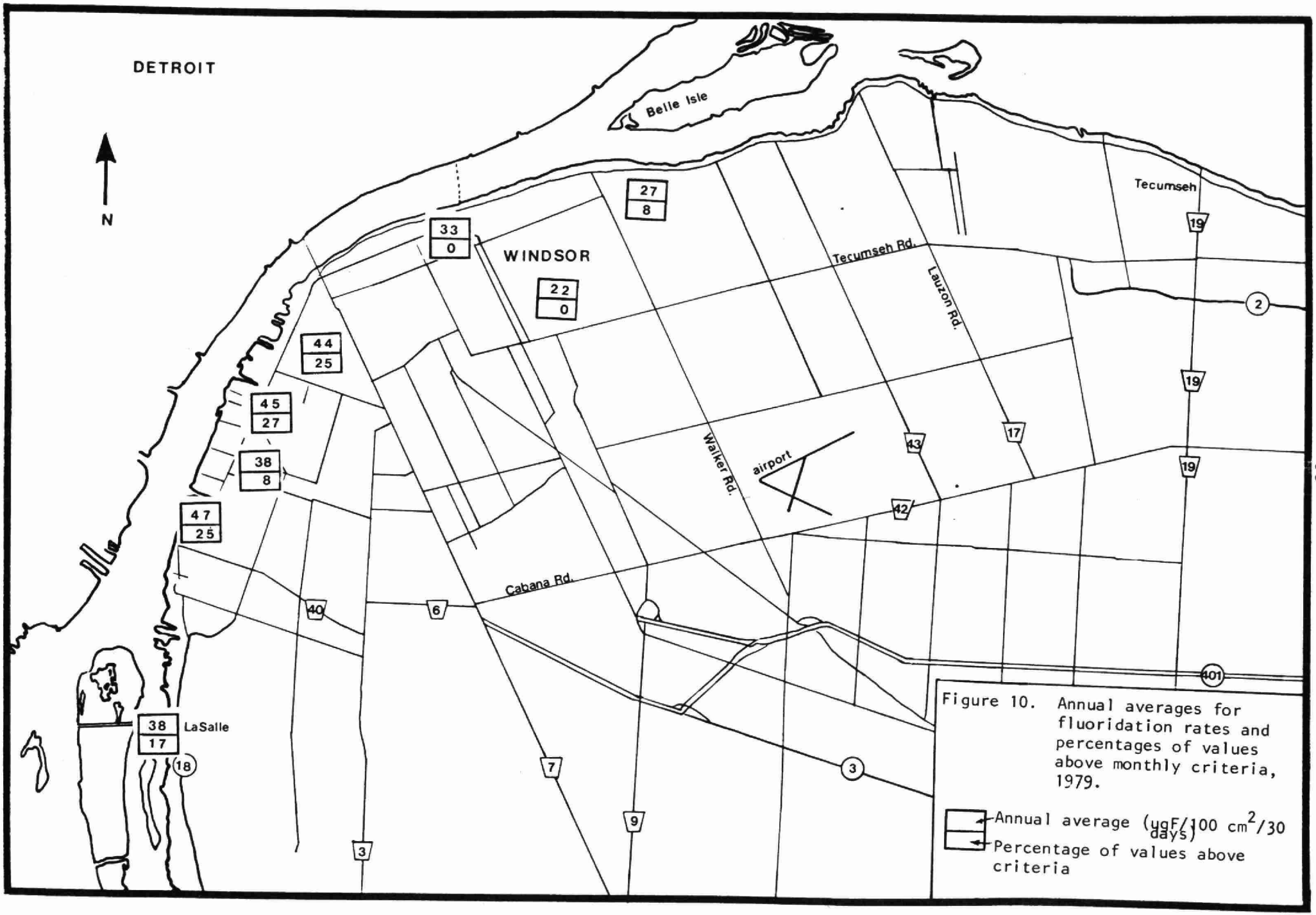


Figure 10. Annual averages for fluoridation rates and percentages of values above monthly criteria, 1979.

Annual average (ugF/100 cm^2/30 days)

Percentage of values above criteria

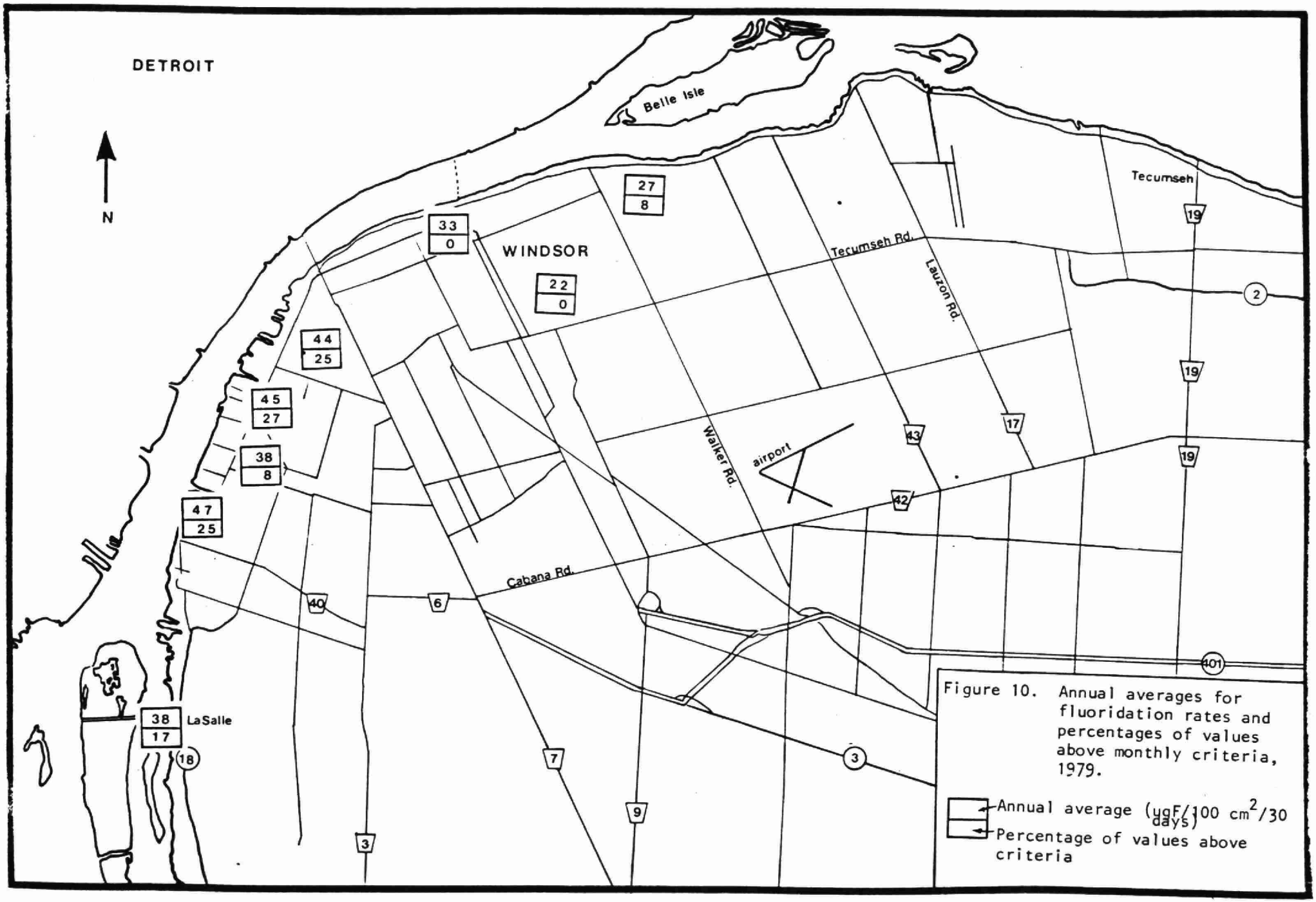


Figure 10. Annual averages for fluoridation rates and percentages of values above monthly criteria, 1979.

Annual average (ugF/100 cm^2/30 days)

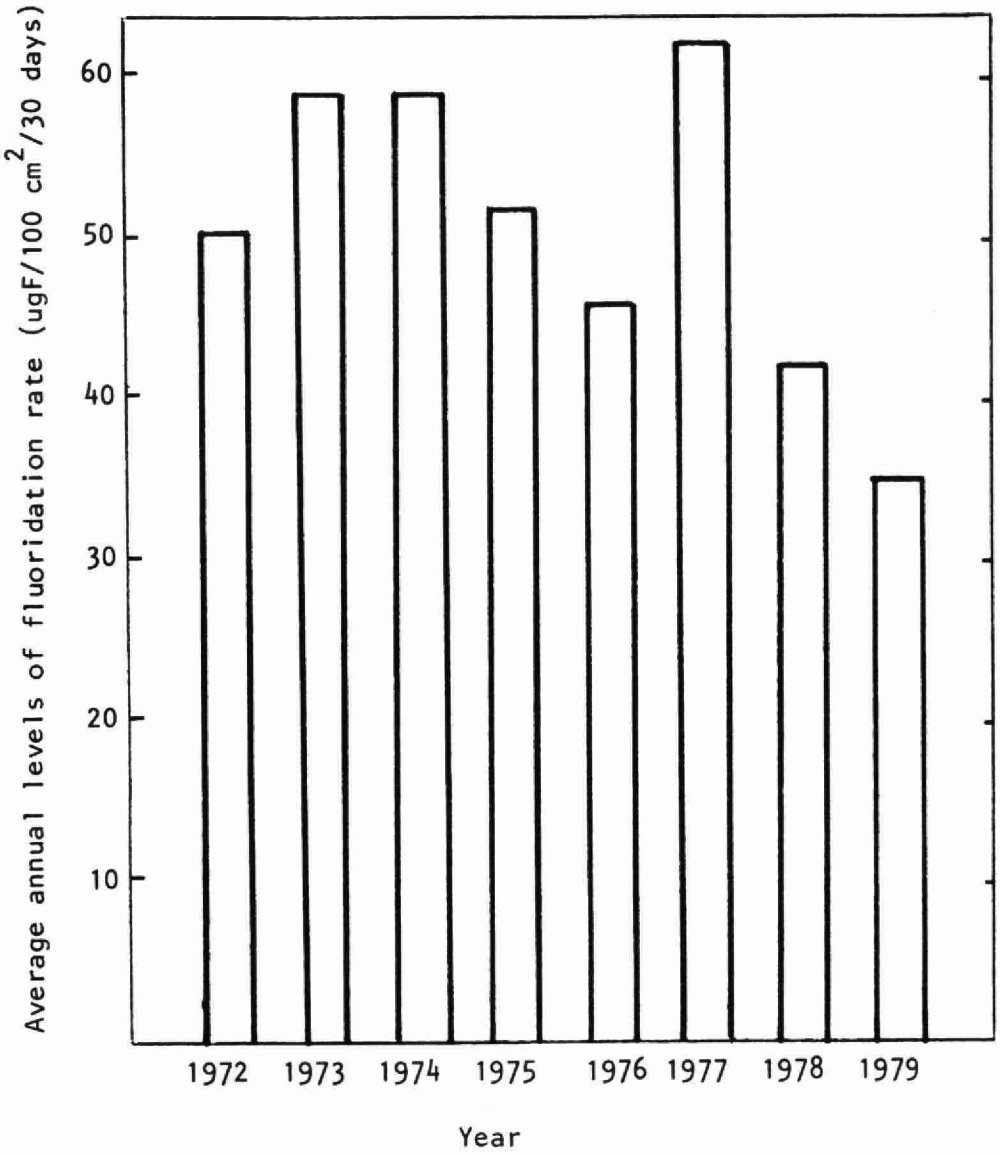
Percentage of values above criteria

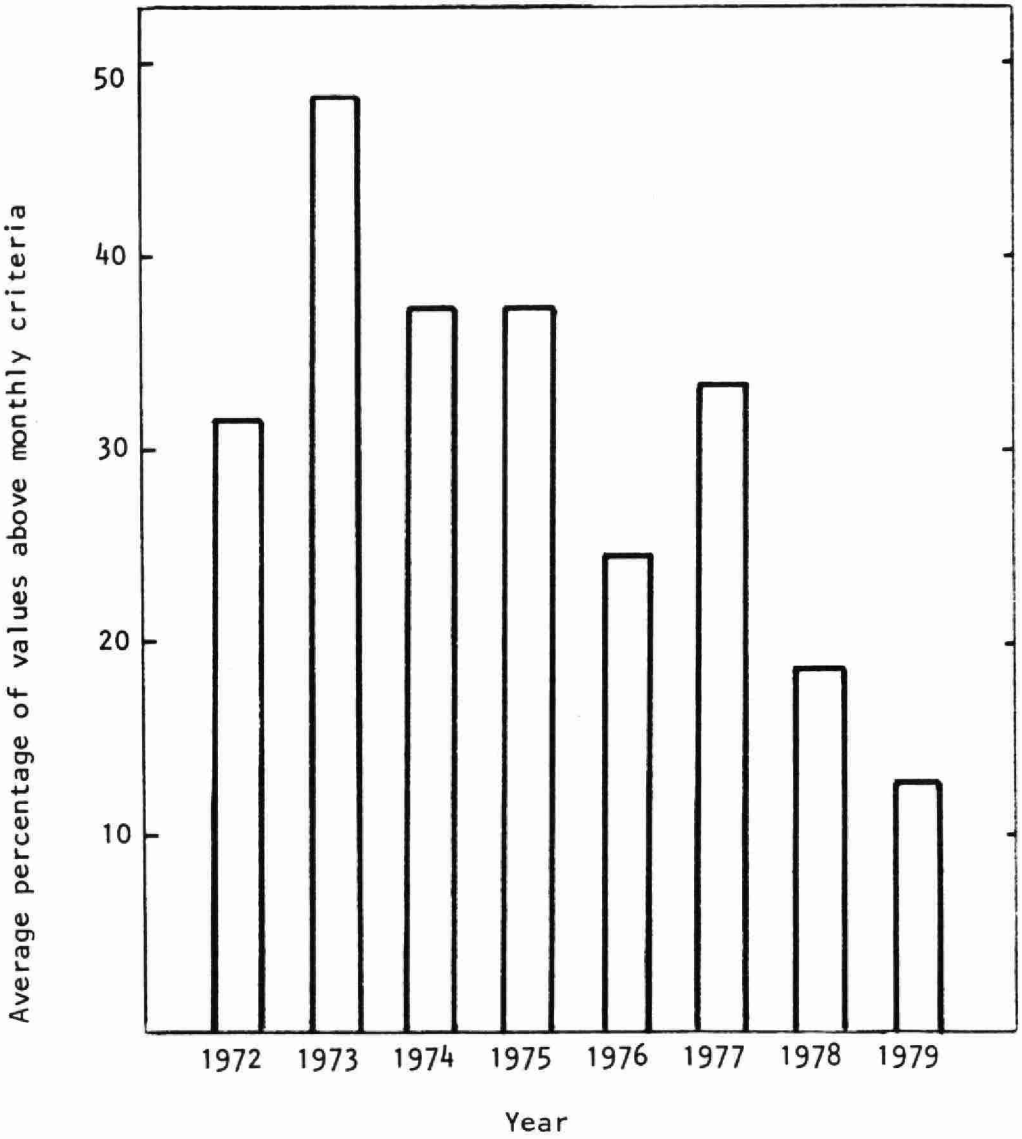
Table 10. Levels of fluoridation rate during 1979

Station Number	Fluoridation rate (ugF/100 cm²/30 days)												Annual Average	Percentage of values above criteria
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec		
12008	63	43	30	27	32	21	40	37	22	14	39	31	33	0
12015	93	47	45	30	44		40	49	30	28	53	37	45	27
12016	99	48	52	35	40	35	42	49	26	21	44	41	44	25
12022	51	29	22	18	30	21	41	33	21	11	25	27	27	8
12027	46	26	18	14	24	21	31	22	18	13	8	26	22	0
12032	49	47	54	46	37	45	45	45	32	44	78	46	47	25
12040	122	59	17	18	23	17	24	16	13	9	24	108	38	17
12045	50	63	35	34	27	33	37	31	47	27	21	50	38	8

NOTE: Underlined values exceed criteria for desirable ambient air quality

Figure 11. Trend in levels of fluoridation rates based on averaged data for six monitoring stations





DATE	ISSUED TO